PEL-2000 Series

Programmable D.C. Electronic Load

FEATURES

- Sequence Function to do High Efficient Load Simulations
- Flexible Configuration with Mainframes and Plug-in Modules
- Multiple Independent Load Inputs up to 8 channels in a Mainframe
- Parallel Connection of Inputs for Higher Load Capacity
- Program Mode to Create Work Routines for Repetitive Tests
- OPP/OCP/OVP/OTP/RVP/UVP Protections
- External Channel Control / Monitoring via Analog Control Connector
- Multiple-Interface USB Device / Host, RS-232C, and GPIB (Optional)

GW INSTEK
Made to Measure Since 1975

Satisfy All Your High Speed Load Simulation Needs

The PEL-2004 and PEL-2002 are multiple channel, programmable DC electronic loads with a modularized structure. The PEL-2000 Series is designed to meet the continuing shift toward high speed operation in today's semiconductor market. As the power supply units, DC-DC converters, and batteries that drive semiconductor circuits need to follow this shift, power supply design, quality inspection and characteristic certification using high-speed performance loads have become necessary. The PEL-2000 Series includes two types of mainframes and 4 types of load modules to accommodate users' requirements in a flexible manner. Any load module combination can used with a mainframe to tailor a test system based on the number of channels, and the maximum load power, voltage and current of each channel. Multiple loads can be connected in parallel to provide a higher-power load to test higher power supply outputs. This flexibility significantly reduces the investment needed for future projects that have differed power requirements.

The PEL-2004 is a 4-slot mainframe with a master control unit to hold 4 load modules, while PEL-2002 is a 2-slot mainframe with master control unit to hold 2 load modules. When the PEL-2004 is configured with 4 load modules rated at 350W each, the PEL-2000 series is able to sink up to 1.4kVA of power.

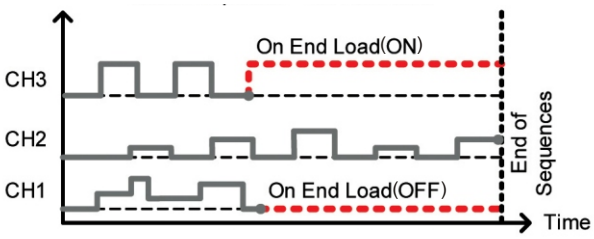
For higher load capacities, mainframes can be linked together in parallel with standard MIL 20-pin connectors. A maximum of 5 mainframes, including one master and 4 slaves can be chained together to create a total load capacity of 7kW for high current and high power applications. Using 4 dual channel load modules, the PEL-2004 is able to test 8 power supply outputs simultaneously.

The Sequence function allows each channel to change its load sink according to a predefined sequence at a rate of up to 100μs per step. Each sequence is able to run concurrently, under the control of one clock. This is one of the most powerful features of the PEL-2000 Series as it is able to realistically simulate a multi-output power supply load. Under Dynamic mode, the load current or load resistance pulses between two preset levels at a pre-defined speed up to 25μs per step. This is often used as the standard test procedure to verify the response of a power supply to quick load changes. Most remarkably, multiple load channels can be connected in parallel to run Dynamic tests synchronously under a single clock. This Parallel Dynamic functionality gives the flexibility to perform dynamic tests for a high-power power supply without the need of another high-power load.

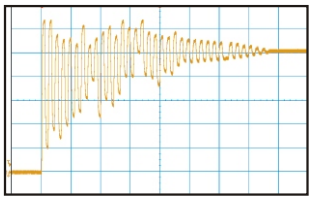
The PEL-2000 Series includes a number of protection modes: Over Current Protection (OCP), Over Voltage Protection (OVP), Over Power Protection (OPP), Reverse Voltage Protection (RVP), and Under Voltage Protection(UVP). The protection modes are useful to protect both the load modules and the DUT(s). A buzzer can be set for when a protection setting has been tripped. When a protection mode has been tripped, the load unit will display an alarm and stop sinking current/voltage. When a load unit is operating in CR or CV mode, the unit may need Over Current Protection to prevent excessive current being sunk. Over Current Protection stops the load from sinking more current than its recommended limit and prevents the load from burn-out damage. Over Voltage Protection is used to limit the amount of voltage sunk. If the OVP trips, the PEL-Series load will stop sinking voltage. Over Power Protection is used when the input power exceeds the specifications of the load. When OPP is tripped, the power will cease to be sunk. Reverse Voltage Protection prevents reverse voltage damage to the PEL-2000 Series up to the specified rating. When Reverse Voltage Protection has been tripped, an alarm tone will sound until the reverse voltage is removed. Under Voltage Protection will turn off the load when the voltage drops below a set limit.

The Go/NoGo function is available to monitor test results all the time. When a test result goes beyond a preset limit range, a "No Go" indication will be shown on the display and a "No Go" signal can be sent out through the D-SUB interface for external device control. This Go/NoGo function is available for CC mode, CV mode and CR mode. Under "Program" mode, 12 programs each containing 10 panel-setup memories, can be edited to create work routines for repetitive tests. After a program has been executed, the results of all test steps, along with the Go/NoGo judgments, will be shown on the screen. For external control and system configuration, the PEL series has USB and RS232 interfaces as standard and GPIB as an option. The LabView driver and Data Logging PC software are both supported for all the available interfaces. Each channel has an analog control/monitoring connector on the rear panel to externally turn a load on/off and to externally monitor load input current and voltage.

A. AUTOMATICALLY SEQUENCE FUNCTION



Sequence - On End Load



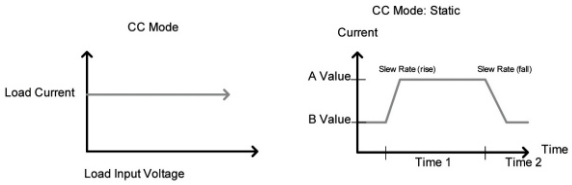
The figure above shows the current waveform of a simulation using the sequence function.

The Sequence function allows each channel to change its load sink according to a predefined sequence at a rate of up to 100μs per step. Each sequence is able to run concurrently, under the control of one clock. This is one of the most powerful features of the PEL-2000 Series as it is able to realistically simulate a multi-output power supply load. Under Dynamic mode, the load current or load resistance pulses between two preset levels at a pre-defined speed up to 25μs per step. This is often used as the standard test procedure to verify the response of a power supply to quick load changes.

The picture above is an example of a sequence used as a load profile for a single output switching power supply. A load profile is programmed to simulate the current draw of a power supply load.
By using a current probe to acquire a current waveform, the PEL-2000 is able to evaluate the performance of a power supply based on the load sequence that is programmed. An oscilloscope is then used to display the result.

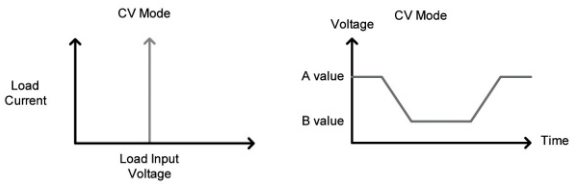
B. MULTIPLE OPERATING MODE

C.C. (Constant Current)



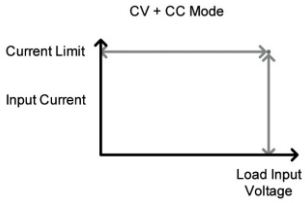
In Constant Current mode, a load unit will sink the amount of current programmed. Regardless of the voltage change, the current will stay the same. Two selectable ranges are available for constant current mode: High (HI) and low (LO) range. Low range has a higher resolution for high precision measurements. If the current exceeds the low range, high range must be used. The PEL-2000 Series offers the maximum rated power for the low measurement range. This unique feature enables high-resolution measurements at high voltage only if the load current doesn't exceed the rated low range level. Both static and dynamic modes are available for CC operation. Static mode can be used for stability tests and Dynamic mode can be used to test transient load performance of a power supply. Go/NoGo is supported for both high and low ranges as well as Static and Dynamic modes.

C.V. (Constant Voltage)



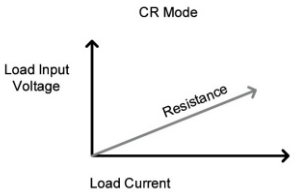
In Constant Voltage mode the load unit will sink current whilst keeping the voltage constant. Under CV mode, single channel load modules support two levels of voltage (A Value, B Value) with a preset cut-off current limit. An A / B button is available on the load module front panels to switch the Constant Voltage between A Value and B Value for power supply load regulation testing. Dual channel load modules only support A Value for CV mode. To accommodate the response of a power supply, response rates during voltage transitions can be set to fast or slow under static test mode.

C.V.+C.C. (Constant Voltage + Constant Current)



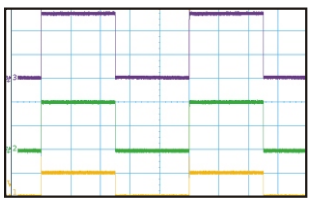
When using CV mode, a current limit can be set for CV+CC mode. If the input voltage is greater than the preset CV limit, the channel will operate in CV mode if the input current is less than the preset CC limit. When the input current exceeds the current limit, the channel will operate in CC mode.

C.R. (Constant Resistance)

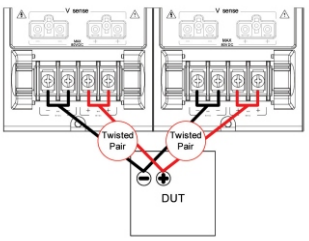


In Constant Resistance mode the load units will linearly sink current and voltage to match a set resistance. Two different CR values and two different rising and falling slew rates can be set under CR Mode for single channel load modules. Like CC mode, Constant Resistance mode supports both dynamic and static loads. As with the other modes, Go/No Go is also supported.

C. PARALLEL DYNAMIC LOADING



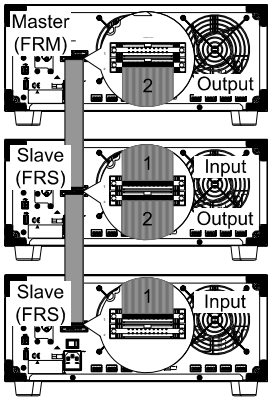
Dynamic Test



Wire Connection

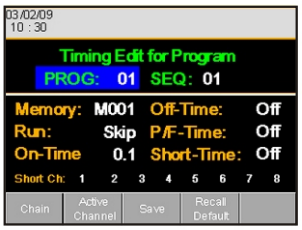
All the load channels in a PEL-2000 mainframe can be connected in parallel to perform any combination of static or dynamic loading. Under Dynamic mode, the load current or load resistance pulses between two preset levels at a predefined speed of up to 25μs per step. When the channels are connected in parallel, dynamic tests are synchronously clocked. The ability to perform parallel dynamic loading gives you the flexibility to perform dynamic tests to high-power power supplies without the need for a dedicated high power electronic load.

D. FRAME LINK



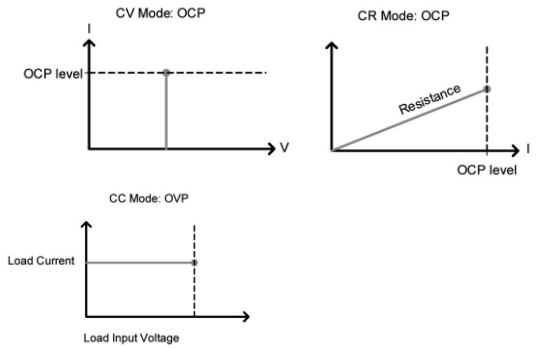
The PEL-2000 Series allows multiple mainframes to be linked together with standard MIL 20-pin connectors to provide higher power load capacity. A maximum of 5 mainframes maximum, including one master and 4 slaves, can be chained together to give a 7kW load capacity for high current and high power applications

E. RUN PROGRAM



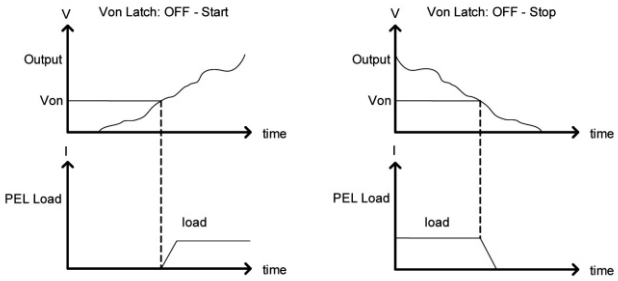
Under "Program" mode, up to 12 programs each with 10 panel setup memories, can be edited to create work routines for repetitive tests. After a program has completed, the results of all test steps, including the Go/NoGo judgments will be shown on the screen. Up to 12 programs with a total of up to 120 panel-setup memories can be chained together to be run one after the other.

F. PROTECTION MODES



The PEL-2000 Series includes a number of protection modes: Over Current Protection (OCP), Over Voltage Protection (OVP), Over Power Protection (OPP), Reverse Voltage Protection (RVP), and Under Voltage Protection (UVP). The protection modes are useful to protect both the load modules and the DUT(s). A buzzer can be set for when a protection setting has been tripped. When a protection mode has been tripped, the load unit will display an alarm and stop sinking current/voltage. When a load unit is operating in CR or CV mode, the unit may need Over Current Protection to prevent excessive current being sunk. Over Current Protection stops the load from sinking more current than its recommended limit and prevents the load from burn-out damage. Over Voltage Protection is used to limit the amount of voltage sunk. If the OVP trips, the PEL-Series load will stop sinking voltage. Over Power Protection is used when the input power exceeds the specifications of the load. When OPP is tripped, the power will cease to be sunk. Reverse Voltage Protection prevents reverse voltage damage to the PEL-2000 Series up to the specified rating. When Reverse Voltage Protection has been tripped, an alarm tone will sound until the reverse voltage is removed. Under Voltage Protection will turn off the load when the voltage drops below a set limit.

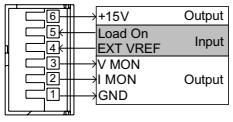
G. Von VOLTAGE SETTINGS



Von Voltage is the voltage limit at which the load will start to sink current. The Von Voltage setting is necessary for some kinds of power supply if a heavy load is connected during load on. There are two operation modes for Von Voltage: Latch ON and Latch OFF. When Von Latch is set to ON, the load starts to sink current when input voltage exceeds Von, and will continue to sink current even if the voltage drops below the Von Voltage later. When Von Latch is set to OFF, the load starts to sink current when input voltage exceeds Von, but will stop sinking current when the voltage drops below the Von voltage setting. This is to prevent the power supply from running into oscillation when the output voltage goes below certain level.

H. EXTERNAL CHANNEL CONTROL

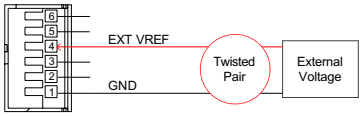
Channel Control / Monitoring Connectors



Pin Assignment for the Channel Control Connectors

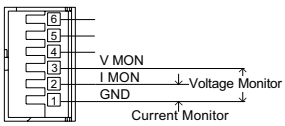
A six-pin analog control connector is available on the rear panel to externally turn a load on/off and to externally monitor the load input status of each channel, including input current, input voltage, and CC current or CV settings. The Voltage Monitor Output (VMON) and Current Monitor Output (IMON) output the load input voltage and load input current as a percentage of rating current/voltage. Where 0 volts = 0% rating and 10 volts = 100% load input rating voltage or current. The voltage monitor output is across pins 1 & 3, and the current monitor output is across pins 1 & 2. Below shows the pin configuration of the voltage and current monitor outputs.

External Voltage Connection

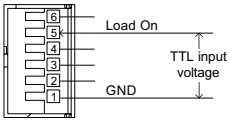


The external voltage reference input must be between 0~10V.

Voltage and Current Monitor Output



Load on Connection



To turn a load on, an active low voltage (0-1V) must be applied across Load On (pin 5) and GND (pin 1), similarly an active high voltage (4-5V) must be applied to turn a load off. The Load On input must be TTL.

PANEL INTRODUCTION

CE | RS-232 | GPIB | USB | LabVIEW Driver

1. Mainframe (Master) LCD Display 320 by 240 TFT LCD
2. Function Keys
3. System Keys
4. Mainframe Operation Keys
5. USB Device Port
6. Load Module Operation Keys
7. V Sense
8. Terminals
9. Selector Knob
10. Go/NoGo Output
11. GPIB
12. RS-232C
13. USB Device / Host Port
14. Mainframe Control Connector
15. External Channel Control 1~8

Modularized Structure

The PEL-2004 is a 4-slot mainframe with a master control unit made to hold 4 load modules, and the PEL-2002 is a 2-slot mainframe with a master control unit made to hold 2 load modules. The modularized structure of the PEL-2000 Series allows any combination of mainframe and load module (PEL-2020, PEL-2030, PEL-2040, PEL-2041) to be integrated into a custom-tailored system.

Multiple loads within the same mainframe can be connected in parallel to perform both static and dynamic tests. This flexibility makes the PEL-2000 Series a very cost-effective instrument for testing a broad range of power supply outputs.

Program & Interface

The PEL-2000 Series supports a total of 12 different programs and 10 sequences to each program. With a total of up to 120 different configurations. For external control and system con figuration, the PEL series has USB and RS-232 interfaces as standard and GPIB as an option. The LabView driver and Data Logging PC software are supported for all the interfaces available. Each channel has an analog control/monitoring connector to externally turn a load on/off and to externally monitor load input current and voltage.

4-Slot Programmable DC Electronic Load Mainframe

PEL-2004

2-Slot Programmable DC Electronic Load Mainframe

PEL-2002

SPECIFICATIONS

	PEL-2020		PEL-2030			PEL-2040		PEL-2041	
CHANEL	L/R	L/R	Left	Right	Right	–	–	–	–
RANGE	Low	High	N/A	Low	High	Low	High	Low	High
POWER	100W	100W	30W	250W	250W	350W	350W	350W	350W
CURRENT	0~2A	0~20A	0~5A	0~4A	0~40A	0~7A	0~70A	0~1A	0~10A
VOLTAGE	1~80V	1~80V	1~80V	1~80V	1~80V	1~80V	1~80V	2.5~500V	2.5~500V
MIN.OPERATING VOLTAGE(DC)	1.0V at 2A	1.0V at 20A	1.0V at 5A	1.0V at 4A	1.0V at 40A	1.0V at 7A	1V at 70A	2.5V at 1A	2.5V at 10A
STATIC MODE									
CONSTANT CURRENT MODE									
Range	0~2A	0~20A	0~5A	0~4A	0~40A	0~7A	0~70A	0~1A	0~10A
Resolution	0.5mA	5mA	1.25mA	1mA	10mA	1mA	10mA	0.2mA	2mA
Accuracy	±(0.1%set + 0.1%F.S.)	±(0.1%set + 0.1%F.S.)	±(0.1%set + 0.1%F.S.)	±(0.1%set + 0.1%F.S.)	±(0.1%set + 0.2%F.S.)	±(0.1%set + 0.1%F.S.)	±(0.1%set + 0.2%F.S.)	±(0.1%set + 0.1%F.S.)	±(0.1%set + 0.2%F.S.)
CONSTANT RESISTANCE MODE									
Range	0.075Ω~300Ω (100W/16V) 3.75Ω~15K (100W/80V)		0.3Ω~1.2KΩ (30W/16V) 15Ω~60K (30W/80V)	0.0375Ω~150Ω (250W/16V) 1.875Ω~7.5K (250W/80V)		0.025Ω~100Ω (350W/16V) 1.25Ω~5K (350W/80V)		1.25Ω~5KΩ (350W/125V) 50Ω~200K (350W/500V)	
Resolution	12bits		12bits	12bits		12bits		12bits	
Accuracy	300Ω: ±(0.2%set+0.1℧) 15KΩ: ±(0.1%set+0.02℧) With≥2.5V at input		12KΩ:±(0.2%set+0.1℧) 60KΩ: ±(0.1%set+0.01℧) With≥2.5V at input	150Ω ±(0.2%set+0.1℧) 7.5KΩ:±(0.1%set+0.02℧) With≥2.5V at input		100Ω:±(0.2%set+0.1℧) 5KΩ: ±(0.1%set+0.02℧) With≥2.5V at input		5KΩ:±(0.2%set+0.02℧) 200KΩ: ±(0.1%set+0.01℧) With≥5V at input	
CONSTANT VOLTAGE MODE									
Range	1~80V		1~80V			1~80V		2.5~500V	
Resolution	20mV		20mV			20mV		100mV	
Accuracy	±(0.05%set+0.1%F.S.)		±(0.05%set+0.1%F.S.)			±(0.05%set+0.1%F.S.)		±(0.05%set+0.1%F.S.)	
DYNAMIC MODE									
CONSTANT CURRENT MODE									
T1&T2	0.025mS~10mS/Res:1μS 1mS ~ 30S / Res : 1mS		0.025mS~10mS/Res:1μS 1mS ~ 30S / Res : 1mS			0.025mS~10mS/Res:1μS 1mS ~ 30S / Res : 1mS		0.025mS~10mS/Res:1μS 1mS ~ 30S / Res : 1mS	
Accuracy	1μS / 1mS ± 100ppm		1μS / 1mS ± 100ppm			1μS / 1mS ± 100ppm		1μS / 1mS ± 100ppm	
Slew Rate(±10%set+15μS)	0.32~80mA/μS	3.2~800mA/μS	0.8~200mA/μS	0.64~160mA/μS	6.4~1600mA/μS	0.001~0.28A/μS	0.01 ~ 2.8A/μS	0.16~40mA/μS	1.6~400mA/μS
Slew Rate Resolution	0.32mA/μS	3.2mA/μS	0.8mA/μS	0.64mA/μS	6.4mA/μS	0.001A/μS	0.01A/μS	0.16mA/μS	1.6mA/μS
Current	0~2A	0~20A	0~5A	0~4A	0~40A	0~7A	0~70A	0~1A	0~10A
Current Resolution	0.5mA	5mA	1.25mA	1mA	10mA	1mA	10mA	0.2mA	2mA
Current Accuracy	±0.4% F.S.	±0.4% F.S.	±0.4%F.S.	±0.4%F.S.	±0.4%F.S.	±0.4%F.S.	±0.4%F.S.	±0.4%F.S.	±0.4%F.S.
MEASUREMENT									
VOLTAGE READBACK									
Range	0~16V	0~80V	0~16V,0~80V	0~16V	0~80V	0~16V	0~80V	0~125V	0~500V
Resolution	0.5mV	2.5mV	0.5mV,2.5mV	0.5mV	2.5mV	0.5mV	2.5mV	4mV	16mV
Accuracy	±(0.05%set +0.05%F.S.)	±(0.05%set +0.05%F.S.)	±(0.05%set +0.05%F.S.)	±(0.05%set +0.05%F.S.)	±(0.05%set +0.05%F.S.)	±(0.05%set +0.05%F.S.)	±(0.05%set +0.05%F.S.)	±(0.05%set +0.05%F.S.)	±(0.05%set +0.05%F.S.)
CURRENT READBACK									
Range	0~2A	0~20A	0~5A	0~4A	0~40A	0~7A	0~70A	0~1A	0~10A
Resolution	0.0625mA	0.625mA	0.15625mA	0.125mA	1.25mA	0.175mA	1.75mA	0.032mA	0.32mA
Accuracy	±(0.1%set +0.1%F.S.)	±(0.1%set +0.1%F.S.)	±(0.1%set +0.1% F.S.)	±(0.1%set +0.1% F.S.)	±(0.1% F.S.)	±(0.1%set +0.1%F.S.)	±(0.1%set +0.1%F.S.)	±(0.1%set +0.1%F.S.)	±(0.1%set +0.1%F.S.)
PROTECTION									
Over Power Protection (±2%set+0.25%F.S.)									
Range	1~102W		1~30.6W	1~255W		1~357W		1~357W	
Resolution	0.5W		0.15W	1.25W		1.75W		1.75W	
Over Current Protection (±2%set+0.25%F.S.)									
Range	0~20.4A		0~5.1A	0~40.8A		0~71.4A		0~10.2A	
Resolution	0.05A		0.0125A	0.1A		0.175A		0.025A	
Over Voltage Protection (±2%set+0.25%F.S.)									
Range	1~81.6V		1~81.6V	1~81.6V		1~81.6V		1~510V	
Resolution	0.2V		0.2V	0.2V		0.2V		1.25V	
Over Temperature Protection	≒85℃		≒85℃	≒85℃		≒85℃		≒85℃	
Rated Power Protection(±2%set)									
Value	110W		33W	275W		385W		385W	
GENERAL									
SHORT CIRCUIT									
Current(CC)	≒2.2/2A	≒22/20A	≒5.5/5A	≒4.4/4A	≒44/40A	≒7.7/7A	≒77/70A	≒1.1/1A	≒11/10A
Voltage(CV)	0V	0V	0V	0V	0V	0V	0V	0V	0V
Resistance(CR)	≒3.75Ω	≒0.075Ω	≒15Ω,≒0.3Ω	≒1.875Ω	≒0.0375Ω	≒1.25Ω	≒0.025Ω	≒50Ω	≒1.25Ω
INPUT RESISTANCE(LOAD OFF)	800KΩ (Typical)		800KΩ (Typical)			800KΩ (Typical)		800KΩ (Typical)	
POWER SOURCE	AC100V ~ 230V ± 10% ; 50Hz / 60Hz ± 2Hz								
WEIGHT	Approx. 3.8 kg								
DIMENSIONS & WEIGHT(PEL-2002)	272 mm (W) X 200 mm (H) X 581 mm (D) ; Approx. 16.1kg(full modules)								
DIMENSIONS & WEIGHT(PEL-2004)	435 mm (W) X 200 mm (H) X 581 mm (D) ; Approx. 24.8kg(full modules)								

Specifications subject to change without notice. EL-2000GD1BH

ORDERING INFORMATION

PEL-2004 4-Slot Programmable DC Electronic Load Mainframe
PEL-2002 2-Slot Programmable DC Electronic Load Mainframe
PEL-2020 Dual Channel Module, (1~80V, 20A, 100W) x 2
PEL-2030 Dual Channel Module, (1~80V, 5A, 30W)+(1~80V, 40A, 250W)
PEL-2040 Single Channel Module, 1~80V, 70A, 350W
PEL-2041 Single Channel Module, 2.5~500V, 10A, 350W

Note : Load module cannot be used without a mainframe

ACCESSORIES

PEL-2002/2004 User Manual x 1, Power Cord x 1
PEL-2020/2030/2040/2041 GTL-120 Test Lead x 1 , GTL-121 Sense Lead x 1

OPTIONAL ASSESSORIES

PEL-001 GPIB Card
PEL-002 PEL-2000 Series Rack Mount Kit
GTL-246 USB Cable
GTL-248 GPIB Cable
GTL-249 Frame Link Cable

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